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The liberal studies curriculum as the basis for an engineering education.

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The experience of twenty-five years of teaching undergraduate engineering students at one of the premier institutions for engineering education in the world, as well as many years also spent teaching social science research methods to doctoral students in engineering systems, have led me to what may seem on its face to be an ironic, if not outright puzzling, conclusion: the ever-increasing technological complexity of our world demands an education that is *less* narrowly focused on the acquisition of technical skills rather than more as the current engineering curriculum might suggest. This is not to say that technical proficiency is unimportant for successful engineering practice; but in and of itself a technical education produces technicians. If engineers want to be creative producers of useful and useable technology, to solve problems that have tremendous social, economic, or political ramifications in addition to their technical challenges, to engage in culture-making and not just the production of gadgets, or to advance into corporate and governmental leadership, they will require the skills and contextual awareness acquired through the broad exposure to social processes, history, human flourishing, and discovery of the natural world encompassed in the liberal studies curriculum.

The current emphasis on STEM education (with its casual conflation of science and math on the one hand, with technology and engineering on the other) makes it easy to forget that science and technology are very different kinds of intellectual enterprises. Science is fundamentally a process of discovery, and not one of innovation. That is to say, it is not the making of things, but the process of finding-out about the world. (In this regard it has more in common with say, sociology, than it does with engineering). It requires a set of coherent and formal frameworks of explicit knowledge to explain nature or reality, even if those frameworks are themselves dependent on the personal knowledge and past experience of each individual living within a particular community. Science may well be a moving target, but it nonetheless has a stable reality as its goal of discovery. Likewise, it is not a utilitarian pursuit, even if its discoveries may sometimes prove to have utilitarian off-shoots.

Technology on the other hand, is grounded in the realm of non-natural things (artifacts) that some people (a community of users) find useful (creates value) when they share its use. It seeks to make or do, to solve a problem, meet a need or generate a new desire. Technology is more than just the artifact though: it also requires a community of believers in a certain way of using it in order to create the added value that we call innovation. Without users, there is no technology, and hence, no innovation.

Despite their very different intellectual bases then, both science and technology are equally embedded in a human context. The successful diffusion of advances in both requires the engagement of a community of believers. For science that community is made up of other scientists, who signal their assent through the process of peer review. For technology that community consists of adopters. In neither case can ‘purely’ rational or technical arguments in and of themselves, produce either successful science or technology.

The liberal studies component of an engineering education serves two absolutely critical purposes then. First, it distinguishes the realm of truth-claims from the realm of making useful artifacts. Second, it provides students with a foundation in the social and community context in which both scientists and engineers have to function as they strive to be successful. Without the breadth of disciplinary exposure that is the hallmark of a 'liberal education' engineers risk marginalizing themselves from the social world from which, and for whom, all innovation must proceed.

Yet how can an integrated education maintain credibility, when neither the humanists and social scientists on the one hand, nor the engineers on the other, expects the other (and with reason) to be able to teach their material. Neither side is generally equipped with interdisciplinary training, and both worry about the possibility of having their expertise watered-down in the effort. Finally, the long reach of past slights perpetuates an environment of mutual distrust, such that one participant in our workshop could casually declaim on the generalized "arrogance" of humanists as a bar to interdisciplinary teaching. Humanisits might harbor the same sentiment in reverse.

Surely it seems to me (deeply committed as I am to interdisciplinary study), a key to the success of an enterprise such as this one is to indeed let the experts teach in their own field. Our project cannot just be one in which the engineers teach a unit on ethics or report on the history of a particular engineering success and failure, etc. Likewise, the technical material prerequisite for becoming a successful engineer should be taught by those with the relevant technical expertise. A model much more likely to yield success then, is one in which we allow, indeed require, engineering-focused students to roam across the curriculum in the same way that the medicine-focused students do, or the law-focused students do, etc. – always keeping an eye on their focus, but not having that dominate the undergraduate curriculum to the exclusion of almost everything else after the first year. A few exceptional faculty members will be fully prepared for team teaching or other kinds of interdisciplinary teaching experiences, and they should be encouraged. But they don't need to carry the whole program. If all students take a broad range of courses as undergraduates, in pursuit of a 'liberal studies in engineering' degree, they should be able to put some of the connections together on their own, especially if they have been exposed to at least one truly interdisciplinary course built into the curriculum as a guide.

This format would address the dual concerns of the engineers and the arts and sciences about expertise. And it would provide for future engineers the solid contextual base that other professionals already receive in their undergraduate educations. A drawback would of course be that a graduating engineering-focused student would still need to go to graduate (professional) school to become a fully licensed engineer. However, once that accreditation process was complete she/he would be a much more useful engineer for projects in the world, and quite possibly less likely to exit the profession over time. The complexities of our technological world demand nothing less.